A SHORT PERIOD OF SOLAR AND METEOROLOGICAL CHANGES.[1]

IN continuation of the inquiries referred to in a former paper on Indian rainfall and solar activity,[2] attention has more recently been devoted to an examination of the variations of pressure over the Indian and other areas.

(1) It is well known that in India during the summer months (April to September) and during the winter months (October to March) low and high pressures respectively prevail. In the case of the latter, the pressure is found to exhibit very remarkable and definite variations, and is in excess every three and a half years on the average, while at these times of excess of high pressure the low pressure during the other six months of the year is deficient; so that every three and a half years or so the high pressure becomes higher and the low pressure is not so low as usual.

(2) Further, this short-period variation which appears in the mean variation of pressure over the whole of India is as well defined in the mean values for individual stations such as Bombay (Fig. 1, Curve F), Calcutta, Madras, Nagpur, &c.

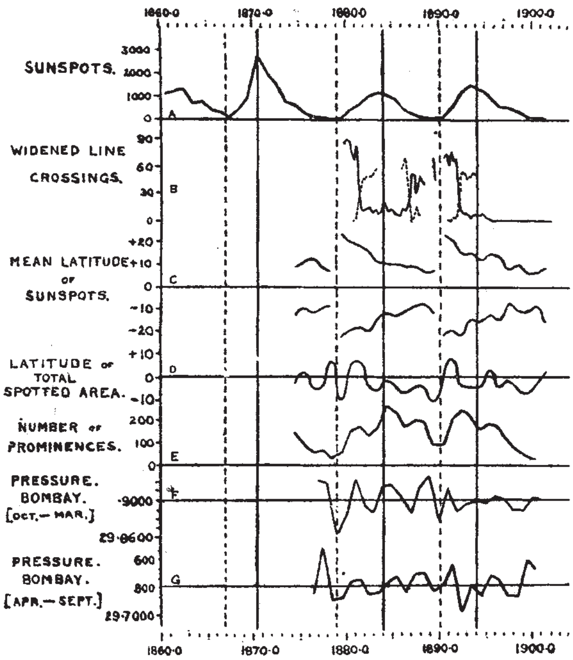

FIG. 1.

(3) The view that the variation of pressure in question over India and its neighbourhood is not due to local causes, but is produced by some external, or extra-terrestrial action, is considerably strengthened by an examination of the pressure curve of a very distant station such as Cordoba. Dealing with the pressures at Cordoba during the high-pressure six months, April to September, the curve (Fig. 2, Curves F and E) representing the variation from the mean from year to year is exactly the *inverse* of the curve representing the Bombay and other Indian pressures for the same months over the same period of time. The cause, therefore, which raises the mean value for the low-pressure months over the Indian area would appear to lower the mean value of high-pressure months at Cordoba simultaneously. In fact we have a see-saw.

(4) Further investigation shows that not only do the pressures of practically the whole Indian area exhibit variations from year to year which present very similar features, but that this is the case with other large areas.

Thus, for instance, it is found that the yearly mean pressures for Brussels, Bremen, Oxford, Valencia and Aberdeen (the only pressures that have been at present examined) are all remarkably similar in their variations from year to year; and it might almost be said that one curve representing the variations from the normal would approximately define the pressures at all these places.

The probable extra-terrestrial origin of these short-period variations led to a detailed examination of the records of the phenomena connected with solar spots and prominences, with a view of seeing whether similar variations, indicating changes in the solar activity, could be detected.

(5) A preliminary reduction of the Italian observations

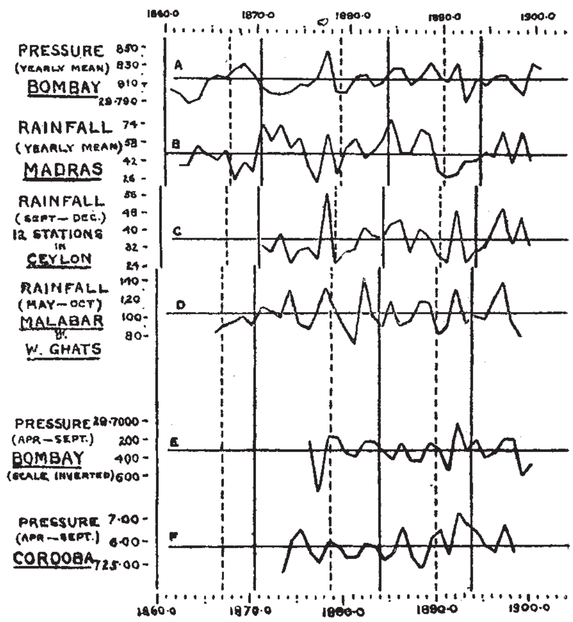

FIG. 2.

of prominences observed on the sun's limb since 1871 was first undertaken. The result of this inquiry indicates that, in addition to the main epochs of maximum and minimum of prominences which coincide in time with those of maximum and minimum of the total spotted area, there are prominent subsidiary maxima and minima having a similar short period, and also coinciding in time (Fig. 1, Curve E).

(6) Although these subsidiary prominence pulses are not distinctly duplicated in the curve representing the spotted area of the solar surface, it is to be noted that corresponding pulses are indicated in the curves which represent the change of latitude of spotted area from year to year; and in each case an increase in prominence activity is associated with a decrease of latitude of the spotted area (Fig. 1, Curves C and D).

(7) A comparison of these solar data with those already referred to relating to terrestrial pressures suggests that these simultaneous outbursts of prominences and changes of the latitudes in which the spots occur about

[1] "On Some Phenomena which Suggest a Short Period of Solar and Meteorological Changes," by Sir Norman Lockyer, K.C.B., F.R.S., and William J. S. Lockyer, M.A., Ph.D., F.R.A.S. (Read before the Royal Society, June 19.)

[2] "On Solar Changes of Temperature and Variations in Rainfall in the Region Surrounding the Indian Ocean" (*Roy. Soc. Proc.* vol. lxvii. p. 409).

every three and a half years are the true cause of the pressure changes; and that the varying intensity of solar activity within the sunspot period of eleven years produces an effect on the pressure and circulation of our atmosphere, thus affecting the whole globe meteorologically.

(8) The close correspondence between the epochs of these subsidiary pressure variations and those representing prominence frequency suggests, not only their very close relationship, but that the terrestrial pressure quickly answers to the solar changes, while so far as the work has gone it would appear that rainfall (Fig. 2, Curves A, B, C, D) and snowfall are subsequent effects.

(9) It may be remarked that we have already obtained evidence showing that this short-period variation is not the only one acting, but that the eleven-year and thirty-five-year periods apparently influence the short-period variations. But even this does not explain some anomalies already met with, and should the solar origin of these short-period pressure changes be subsequently confirmed, some of them not constant in all localities will have to be explained: and it is possible we may obtain in this way some new knowledge on the atmospheric circulation.

(10) The period of time included in this survey begins generally with the establishment of the full records of the Indian Meteorological Department in 1875 and extends to 1895, when the regularity of the widened-line phenomena was broken, as stated in a previous communication.

Addendum, dated June 26.

In continuing the above researches we have plotted the percentage frequency of the solar prominences derived from the Italian observations for each 10° of solar latitude N. and S. of the equator.

We find that the epochs of maximum prominence disturbance in the higher latitudes are widely different from those near the equator. The latter are closely associated with the epochs of maximum spotted area, the former occur both N. and S. at intervening times.

We have, then, two sets of strongly marked prominence outbursts occurring at intervals of between three and four years.

Both sets are represented closely in the Indian pressure curves.

Solar Physics Observatory.

THE FIRST MAGNETICIAN.[1]

"THIS booke is not for every rude and unconnynge man to see, but for clerkys and very gentylmen that understand gentylness and scyence."

This quotation from Caxton is prefixed by Prof. Thompson to his notes to the new edition of the "De Magnete."

Most students of electricity know that William Gilbert of Colchester is the father of the sciences of magnetism and electricity. They may have some idea of the extent of his discoveries and the general character of his work, but few who have not seen the celebrated book in which he recorded his results can have really grasped how much Gilbert knew and how thorough and complete were his investigations.

"He practised the experimental method of observation before Bacon wrote about it; his methods and discoveries excited the sneers of Bacon, the praises of Galileo and Kepler."

The book justifies the high claim put forward on its behalf by its latest editor, and the thanks of men of science are due to him and to all who have helped him for enabling them to learn what Gilbert did.

It was a happy thought to found the Gilbert Club, and the members of the club who have the chance of possessing this splendid volume, the outcome of many years of patient research and loving labour, are greatly to be envied.

The club was founded in 1889 to commemorate Gilbert's work and to issue a translation in English; at that date there was none, though one was published in America in 1893 The original edition was issued in 1600, and it was at first hoped that the translation might be ready in time for the tercentenary celebration at Colchester in 1900. This proved impossible, but the work is now complete and the result is admirable.

It will be of interest here to give a brief account of the work itself. Starting with the early history of the loadstone, its power of attracting iron known to the ancients and its property of setting in a definite direction discovered in the tenth or twelfth century, Gilbert in the first book of his treatise sets forth the various fundamental properties of a magnet and of magnetised iron, illustrating them by the experiments now familiar to all, and describing almost in every chapter some new discovery or some important law. He is continually appealing to experiment and accurate observation. "Deplorable is man's ignorance in natural science," he writes, "and modern philosophers like those who dream in darkness need to be aroused and taught the uses of things and how to deal with them, and to be induced to leave the learning sought at leisure from books alone and that is supported only by unrealities of arguments and by conjectures" But Gilbert lived too early; it was more than 200 years before the truth of his maxim was realised.

He was quick to appreciate at their true value the inaccurate observations of some who had gone before him.

"Albertus Magnus writes," we are told, "that a loadstone had been found in his day which with one part drew to itself iron and repelled it with the other end; but Albertus observed the facts badly; for every loadstone attracts with one end iron that has been touched by a loadstone and drives it away with the other."

Among other things, we may note his observation that "a long piece of iron (even though not excited by a magnet) settles itself toward north and south"; but perhaps the greatest discovery in this book is contained in the last chapter, "That the globe of the earth is magnetick and a magnet," our "New and unheard of doctrine about the earth" he calls it. The doctrine is proved by the observations and experiments which are the subject of the rest of the treatise.

Book ii. deals with a number of examples of magnetic attraction, and in chapter ii., "On the magnetic coition, and first on the attraction of amber, or more truly on the attaching of bodies to amber," we find the beginnings of the theory of electricity. "For in other bodies," he writes, "a conspicuous force of attraction manifests itself otherwise than in loadstone; like as in amber, concerning which some things must first be said that it may appear what is that attaching of bodies and how it is different from and foreign to the magnetical actions, those mortals being still ignorant who think that inclination to be an attraction and compare it with the magnetic coitions," and so to illustrate electric actions he invents the straw electroscope. He divides bodies into "electricks," which are electrified by friction and attract light bodies, and "non-electricks," the metals and other conductors as we now call them. The effect of heat and moisture is studied and described, and the distinction between electrical and magnetic attraction fully made out.

With amber or other "electricks," "if indeed either a sheet of paper or a piece of linen be interposed there will be no movement. But a loadstone without friction

[1] "William Gilbert of Colchester, Physician of London, on the Magnet, Magnetic Bodies also, and on the Great Magnet the Earth." Pp. 246. Published in Latin, 1600. Translated and edited for the Gilbert Club, 1900, with notes by Prof. S. P. Thompson, F.R.S.